

CLAIMS

1. A mechanical locking mechanism for stopping a movable shaft capable of reciprocation, comprising:

5 movable shaft drive means for converting rotary motion of a drive to motion of a prescribed direction in order to supply reciprocation to said movable shaft; and

10 safety means for restraining rotation of a rotary shaft of said drive by a mechanical operation when said movable shaft moves beyond a predetermined position.

2. The mechanical locking mechanism according to claim 1, wherein said safety means includes:

15 locking means provided in the vicinity of said rotary shaft to be capable of restraining rotation of the rotary shaft of said drive, and

 trigger means mechanically operating said locking means so that said locking means restrains said rotary shaft when said movable shaft moves beyond the predetermined position.

20 3. The mechanical locking mechanism according to claim 2, wherein said locking means is

 provided to be capable of selecting a first position fixing rotation of said rotary shaft and a second position liberating rotation of said rotary shaft, and

25 said trigger means includes:

 a detection mechanism for mechanically detecting a moving end of said movable shaft, and

30 a link mechanism setting said locking means on the first position by said detection mechanism when said movable shaft moves beyond the predetermined position.

4. The mechanical locking mechanism according to claim 3, wherein said locking means includes:

a fixed lock ring provided around said rotary shaft and including a groove portion having such a sliding surface that the distance between said sliding surface and the center of said rotary shaft gradually shortens along a prescribed rotational direction of said rotary shaft on a side facing said rotary shaft,

a lock pin arranged in said groove portion, and

a movable lock ring holding said lock pin to be movable between a first position locating said lock pin between a surface of said sliding surface most shortening the distance between said sliding surface and said rotary shaft and said rotary shaft and restraining rotation of said rotary shaft by a wedge effect and a second position liberating rotation of said rotary shaft in said groove portion.

5. The mechanical locking mechanism according to claim 3, wherein said detection mechanism includes:

a follower rotary shaft rotating following rotation of said drive,

a body plate having the same rotation center as the rotation center of said follower rotary shaft,

a first gear, having the same rotation center as the rotation center of said follower rotary shaft, to which rotation of said follower rotary shaft is transmitted through a first gear mechanism supported on the peripheral portion of said body plate, and

a second gear having the same rotation center as the rotation center of said follower rotary shaft, having a specific rotation control mechanism and arranged to be opposite to said first gear,

a surface of either one of said first gear and said second gear opposed to the other gear is provided with a pin projecting toward the other gear and a surface of the other gear opposed to one of the gears is provided with a ring-shaped guide slit having both end portions extending along the rotation locus of the pin to be capable of receiving said pin, and

said link mechanism has:

an engaging pin provided on said movable lock ring,

an operating mechanism provided to be rotatable about a prescribed

axis for rotating said movable lock ring so that said lock pin is on the first position with an end engaging with said engaging pin, and

5 a link bar having an end coupled to the peripheral portion of said body plate by a universal joint and another end coupled to the other end of said operating mechanism by a universal joint.

10 6. The mechanical locking mechanism according to claim 5, wherein said operating mechanism has electric signal generation means converting movement of said operating mechanism to an electric signal.

7. The mechanical locking mechanism according to claim 3, wherein said detection means has means limiting the stroke of said movable shaft.

15 8. An injector head provided therein with a syringe filled with a contrast medium, comprising:

a plunger capable of reciprocating in a direction of movement of a piston in said syringe;

20 plunger drive means for converting rotary motion of a motor to linear motion in order to supply reciprocation to said plunger; and

safety means for restraining rotation of a rotary shaft of said motor by a mechanical operation when said plunger moves beyond a predetermined position.

25 9. The injector head according to claim 8, wherein said safety means includes:

locking means provided in the vicinity of said rotary shaft to be capable of restraining rotation of the rotary shaft of said motor, and

30 trigger means mechanically operating said locking means so that said locking means restrains said rotary shaft when said plunger moves beyond the predetermined position.

10. The injector head according to claim 9, wherein

said locking means is
provided to be capable of selecting a first position fixing rotation of
said rotary shaft and a second position liberating rotation of said rotary
shaft, and

5 said trigger means includes:

 a detection mechanism for mechanically detecting a moving end of
said plunger, and

 a link mechanism setting said locking means on the first position by
said detection mechanism when said plunger moves beyond the
10 predetermined position.

11. The injector head according to claim 10, wherein
said locking means includes:

15 a fixed lock ring provided around said rotary shaft and including a
groove portion having such a sliding surface that the distance between said
sliding surface and the center of said rotary shaft gradually shortens along
a prescribed rotational direction of said rotary shaft on a side facing said
rotary shaft,

20 a lock pin arranged in said groove portion, and

 a movable lock ring holding said lock pin to be movable between a
first position locating said lock pin between a surface of said sliding surface
most shortening the distance between said sliding surface and said rotary
shaft and said rotary shaft and restraining rotation of said rotary shaft by a
wedge effect and a second position liberating rotation of said rotary shaft in
25 said groove portion.

12. The injector head according to claim 10, wherein
said detection mechanism includes:

30 a follower rotary shaft rotating following rotation of said drive,

 a body plate having the same rotation center as the rotation center of
said follower rotary shaft,

 a first gear, having the same rotation center as the rotation center of
said follower rotary shaft, to which rotation of said follower rotary shaft is

transmitted through a first gear mechanism supported on the peripheral portion of said body plate, and

a second gear having the same rotation center as the rotation center of said follower rotary shaft, having a specific rotation control mechanism and arranged to be opposite to said first gear,

a surface of either one of said first gear and said second gear opposed to the other gear is provided with a pin projecting toward the other gear and a surface of the other gear opposed to one of the gears is provided with a ring-shaped guide slit having both end portions extending along the rotation locus of the pin to be capable of receiving said pin, and

said link mechanism has:

an engaging pin provided on said movable lock ring,

an operating mechanism provided to be rotatable about a prescribed axis for rotating said movable lock ring so that said lock pin is on the first position with an end engaging with said engaging pin, and

a link bar having an end coupled to the peripheral portion of said body plate by a universal joint and another end coupled to the other end of said operating mechanism by a universal joint.

13. The injector head according to claim 12, wherein said operating mechanism has electric signal generation means converting movement of said operating mechanism to an electric signal.

14. The injector head according to claim 10, wherein said detection means has means limiting the stroke of said plunger.